

Amendments to the Claims

1 Claim 16 (currently amended): A computer implemented method for programmatically creating a  
2 distributed object program in which at least one complex object is passed as a parameter, wherein  
3 the programmatically-created program is programmatically generated from a programmer-written  
4 program which is not specially adapted for distributed execution, the distributing one or more  
5 objects of a program across more than one physical device, each object containing one or more  
6 programmed member functions, said member functions having complex objects, said complex  
7 objects including one or more programmed member functions, as parameters, said method  
8 comprising the computer executable steps of:

9 identifying all of the one or more objects in the programmer-written program, wherein  
10 each of the objects contains one or more programmed member functions and wherein at least one  
11 of the programmed member functions is written to pass one of the objects as a parameter;

12 determining a first set which of the identified objects which are to reside on a first  
13 computer and a second set which of the identified objects which are to reside on a second  
14 computer, wherein the first set and the second set together comprise the identified objects of the  
15 programmer-written program and the first set and the second set each include at least one of the  
16 identified objects; such that the distributed system will consist of at least a first object on a first  
17 computer and a second object on a second computer;

18 identifying all programmed methods contained in each object that may be accessed from a  
19 remote computer;

20 programmatically generating, upon detecting that a first object in the first set contains  
21 logic to call one of the programmed member functions of a second object in the second set, a first

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22 proxy and a second proxy for each the second object, wherein the first proxy is generated to be  
23 installed on the first computer and the second proxy is generated to be installed on the second  
24 computer;

25 programmatically generating logic in the first proxy that will programmatically generate a  
26 third proxy, responsive to detecting that the call to the programmed member function of the  
27 second object will pass, as a parameter, a third object that is a complex object and that is one of  
28 the objects in the first set, wherein the third proxy is generated to be installed on the first  
29 computer; and

30 programmatically generating logic in the second proxy that will programmatically generate  
31 a fourth proxy, responsive to a call from the first proxy that includes a reference to the third  
32 proxy, wherein the fourth proxy is generated to be installed on the second computer;

33 such that, at run time, the first object can transparently access the programmed member  
34 function of the second object and the programmed member function of the second object can  
35 transparently access a programmed member function of the third object, that may be accessed  
36 from a remote computer, said first proxy residing on said first computer and said second proxy  
37 residing on said second computer, said first proxy containing network linkage and indication to  
38 access programmed member functions on said second proxy on said second computer including  
39 logic to transfer and translate complex objects which reside on said first computer used as  
40 member function parameters and said second proxy containing linkage and indication to access  
41 said programmed member functions on said second object including logic to transfer and translate  
42 complex objects, said complex objects containing one or more programmed member functions  
43 and reside on said first computer, used as member function parameters; and;

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44 ~~accessing said remote programmed methods through said proxies.~~

1 Claim 17 (currently amended): ~~A method~~ The method as claimed in Claim 16, wherein:

2 said the logic in said first proxy further comprises programmatically-generated logic to on  
3 said first computer to transfer and translate complex data objects comprising the steps of:

4 ~~creating a third proxy, for said complex object, which is to reside on said first computer~~  
5 ~~with said complex object, said third proxy containing linkage and indication to access~~  
6 ~~programmed member functions on said complex object;~~

7 ~~creating~~ (1) create a reference table entry which correlates said the third proxy  
8 object to said complex the third object, which may be accessed by said the third proxy object to  
9 access said complex when invoking programmed member functions of the third object; (2)  
10 translate calls for the programmed member function of the second object that are received from  
11 the first object and that pass the third object as a parameter, whereby a reference to the third  
12 proxy replaces the third object on the received calls, and forward the translated calls to the second  
13 proxy; and (3) upon receiving, from the second proxy, responses to the translated calls, return the  
14 responses to the first object; ; and;

15 ~~passing as a member function parameter to said second proxy on said second~~  
16 ~~machine a reference to said third proxy, in place of said complex object when said complex~~  
17 ~~object is to be a parameter in a member function call to said second object on said second~~  
18 ~~machine.~~

19 said logic in said the second proxy further comprises programmatically-generated logic to  
20 on said second computer to transfer and translate complex data objects comprising the steps of:

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21 ~~creating a fourth proxy for said complex object on said first computer which is to~~  
22 ~~reside on said second computer, said fourth proxy containing network linkage and indication~~  
23 ~~necessary to access programmed member functions on said third proxy on said first machine;~~  
24 ~~creating a~~ (1) create a second reference table entry which correlates said the fourth  
25 proxy to a to the reference to said the third proxy on said third computer, which may be accessed  
26 by said the fourth proxy to access said when forwarding calls to the third proxy; (2) invoke the  
27 programmed member function of the second object, responsive to receiving one of the translated  
28 calls that is forwarded from the first proxy, wherein the second reference table entry is consulted  
29 so that an indication of the fourth proxy is substituted, on the invocation, for the reference to the  
30 third proxy; and (3) upon receiving, from the programmed member function of the second object,  
31 a response to the forwarded call, return the response to the first proxy;

32 the fourth proxy further comprises programmatically-generated logic to (1) consult the  
33 second reference table entry, responsive to receiving a call from the programmed member  
34 function of the second object, thereby determining that the received call corresponds to the third  
35 proxy; (2) translate the call received from the programmed member function of the second object  
36 such that the translated call refers to the third proxy and forward the translated call to the third  
37 proxy; and (3) upon receiving, from the third proxy, a response to the translated call, return the  
38 response to the programmed member function of the second object; and

39 the third proxy further comprises programmatically-generated logic to (1) consult the  
40 reference table entry, responsive to receiving the translated call from the fourth proxy, thereby  
41 determining that the received translated call corresponds to the third object; (2) translate the call  
42 received from the fourth proxy to invoke the programmed member function of the third object

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43 and forward the translated call to the third object, where the programmed member function of the  
44 third object will then be executed; and (3) upon receiving, from the programmed member function  
45 of the third object, a result of the execution, return the result to the fourth proxy.;

46 ~~\_\_\_\_\_ passing as a member function parameter to said second object from said second~~  
47 ~~proxy on said second computer an indication of said fourth proxy, in place of said reference to~~  
48 ~~said third proxy on said first computer, which represents said complex object on said first~~  
49 ~~computer.~~

50 ~~\_\_\_\_\_ said network linkage and indication in said fourth proxy necessary to access programmed~~  
51 ~~member functions on said third proxy on said first computer comprising the steps of:~~

52 ~~\_\_\_\_\_ looking up said fourth proxy in said reference table on said second computer to~~  
53 ~~determine which object on said first machine said fourth object is a proxy for, said lookup~~  
54 ~~returning a reference to said third proxy on said first computer;~~

55 ~~\_\_\_\_\_ calling the appropriate programmed member functions in said third proxy on said~~  
56 ~~first computer.~~

57 ~~\_\_\_\_\_ said linkage and indication in said third proxy necessary to access programmed methods~~  
58 ~~on said complex object comprising the steps of:~~

59 ~~\_\_\_\_\_ looking up said third proxy in said reference table on said first computer to~~  
60 ~~determine which object on said first machine said third object is a proxy for, said lookup returning~~  
61 ~~a reference to said complex object on said first computer;~~

62 ~~\_\_\_\_\_ calling the appropriate programmed member functions in said complex object.~~

1 Claim 18 (currently amended): A method The method as claimed in Claim 17 wherein 16,

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2 wherein one of said complex objects the third object is said identical to the first object, such that  
3 the call to the programmed member function of the second object executes as a callback on the  
4 first object, on said first computer.

1 Claim 19 (currently amended): ~~A method~~ The method as claimed in Claim 16, ~~wherein~~ +7  
2 wherein said the reference table entry and the second reference table entry are created as is a  
3 database entries.

1 Claim 20 (currently amended): A computer program product for programmatically creating a  
2 distributed object program in which at least one complex object is passed as a parameter, wherein  
3 the programmatically-created program is programmatically generated from a programmer-written  
4 program which is not specially adapted for distributed execution, the distributing one or more  
5 objects of a program across more than one physical device, each object containing one or more  
6 programmed member functions, said member functions having complex objects, said complex  
7 objects including one or more programmed member functions, as parameters, said computer  
8 program product comprising:

9 a computer-readable storage medium have computer-readable program code means  
10 embodied in said medium, said computer-readable program code means comprising:

11 computer-readable program code means for identifying ~~all of the~~ one or more  
12 objects in the programmer-written program, wherein each of the objects contains one or more  
13 programmed member functions and wherein at least one of the programmed member functions is  
14 written to pass one of the objects as a parameter;

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15 computer-readable program code means for determining a first set which of the  
16 identified objects which are to reside on a first computer and which a second set of the identified  
17 objects which are to reside on a second computer, wherein the first set and the second set  
18 together comprise the identified objects of the programmer-written program and the first set and  
19 the second set each include at least one of the identified objects; such that the distributed system  
20 will consist of at least a first object on a first computer and a second object on a second computer;  
21 ~~computer-readable program code means for identifying all programmed methods~~  
22 ~~contained in each object that may be accessed from a remote computer;~~

23 computer-readable program code means for programmatically generating, upon  
24 detecting that a first object in the first set contains logic to call one of the programmed member  
25 functions of a second object in the second set, a first proxy and a second proxy for each the  
26 second object, wherein the first proxy is generated to be installed on the first computer and the  
27 second proxy is generated to be installed on the second computer;

28 computer-readable program code means for programmatically generating logic in  
29 the first proxy that will programmatically generate a third proxy, responsive to detecting that the  
30 call to the programmed member function of the second object will pass, as a parameter, a third  
31 object that is a complex object and that is one of the objects in the first set, wherein the third  
32 proxy is generated to be installed on the first computer; and

33 computer-readable program code means for programmatically generating logic in  
34 the second proxy that will programmatically generate a fourth proxy, responsive to a call from the  
35 first proxy that includes a reference to the third proxy, wherein the fourth proxy is generated to be  
36 installed on the second computer.

37 such that, at run time, the first object can transparently access the programmed member  
38 function of the second object and the programmed member function of the second object can  
39 transparently access a programmed member function of the third object, that may be accessed  
40 ~~from a remote computer, said first proxy residing on said first computer and said second proxy~~  
41 ~~residing on said second computer, said first proxy containing network linkage and indication to~~  
42 ~~access programmed member functions on said second proxy on said second computer including~~  
43 ~~logic to transfer and translate complex objects which reside on said first computer used as~~  
44 ~~member function parameters and said second proxy containing linkage and indication to access~~  
45 ~~said programmed member functions on said second object including logic to transfer and translate~~  
46 ~~complex objects, said complex objects containing one or more programmed member functions~~  
47 ~~and reside on said first computer, used as member function parameters, and,~~  
48 ~~computer-readable program code means for accessing said remote programmed~~  
49 ~~methods through said proxies.~~

1 Claim 21 (currently amended): A computer The computer program product as claimed in Claim  
2 20, wherein:

3 ~~said logic in said~~ the first proxy on said first computer to transfer and translate complex  
4 ~~data objects comprising the steps of:~~

5 ~~creating a third proxy, for said complex object, which is to reside on said first~~  
6 ~~computer with said complex object, said third proxy containing linkage and indication to access~~  
7 ~~programmed member functions on said complex object;~~

8 ~~creating~~ further comprises programmatically-generated logic to (1) create a



9 reference table entry which correlates said the third proxy object to ~~said complex~~ the third object,  
10 which may be accessed by said the third proxy object to ~~access said complex~~ when invoking  
11 programmed member functions of the third object; (2) translate calls for the programmed member  
12 function of the second object that are received from the first object and that pass the third object  
13 as a parameter, whereby a reference to the third proxy replaces the third object on the received  
14 calls, and forward the translated calls to the second proxy; and (3) upon receiving, from the  
15 second proxy, responses to the translated calls, return the responses to the first object; ; and,  
16 ~~\_\_\_\_\_ passing as a member function parameter to said second proxy on said second~~  
17 ~~machine a reference to said third proxy, in place of said complex object when said complex~~  
18 ~~object is to be a parameter in a member function call to said second object on said second~~  
19 ~~machine.~~  
20 ~~\_\_\_\_\_ said logic in said the second proxy on said second computer to transfer and translate~~  
21 ~~complex data objects comprising the steps of:~~  
22 ~~\_\_\_\_\_ creating a fourth proxy for said complex object on said first computer which is to~~  
23 ~~reside on said second computer, said fourth proxy containing network linkage and indication~~  
24 ~~necessary to access programmed member functions on said third proxy on said first machine;~~  
25 ~~\_\_\_\_\_ creating a further comprises programmatically-generated logic to (1) create a~~  
26 ~~second reference table entry which correlates said the fourth proxy to a to the reference to said~~  
27 ~~the third proxy on said third computer, which may be accessed by said the fourth proxy to access~~  
28 ~~said when forwarding calls to the third proxy; (2) invoke the programmed member function of the~~  
29 ~~second object, responsive to receiving one of the translated calls that is forwarded from the first~~  
30 ~~proxy, wherein the second reference table entry is consulted so that an indication of the fourth~~

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31 . proxy is substituted on the invocation, for the reference to the third proxy; and (3) upon  
32 receiving, from the programmed member function of the second object, a response to the  
33 forwarded call, return the response to the first proxy;

34 the fourth proxy further comprises programmatically-generated logic to (1) consult the  
35 second reference table entry, responsive to receiving a call from the programmed member  
36 function of the second object, thereby determining that the received call corresponds to the third  
37 proxy; (2) translate the call received from the programmed member function of the second object  
38 such that the translated call refers to the third proxy and forward the translated call to the third  
39 proxy; and (3) upon receiving, from the third proxy, a response to the translated call, return the  
40 response to the programmed member function of the second object; and

41 the third proxy further comprises programmatically-generated logic to (1) consult the  
42 reference table entry, responsive to receiving the translated call from the fourth proxy, thereby  
43 determining that the received translated call corresponds to the third object; (2) translate the call  
44 received from the fourth proxy to invoke the programmed member function of the third object  
45 and forward the translated call to the third object, where the programmed member function of the  
46 third object will then be executed; and (3) upon receiving, from the programmed member function  
47 of the third object, a result of the execution, return the result to the fourth proxy; -

48 ~~passing as a member function parameter to said second object from said second~~  
49 ~~proxy on said second computer an indication of said fourth proxy, in place of said reference to~~  
50 ~~said third proxy on said first computer, which represents said complex object on said first~~  
51 ~~computer.~~

52 ~~said network linkage and indication in said fourth proxy necessary to access programmed~~

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53 member functions on said third proxy on said first computer comprising the steps of:  
54 ~~looking up said fourth proxy in said reference table on said second computer to~~  
55 ~~determine which object on said first machine said fourth object is a proxy for, said lookup~~  
56 ~~returning a reference to said third proxy on said first computer;~~  
57 ~~calling the appropriate programmed member functions in said third proxy on said~~  
58 ~~first computer.~~  
59 ~~said linkage and indication in said third proxy necessary to access programmed methods~~  
60 ~~on said complex object comprising the steps of:~~  
61 ~~looking up said third proxy in said reference table on said first computer to~~  
62 ~~determine which object on said first machine said third object is a proxy for, said lookup returning~~  
63 ~~a reference to said complex object on said first computer;~~  
64 ~~calling the appropriate programmed member functions in said complex object.~~

1 Claim 22 (currently amended): ~~A computer~~ The computer program product as claimed in Claim  
2 ~~21 wherein one of said complex objects 20, wherein the third object is said identical to the first~~  
3 ~~object, such that the call to the programmed member function of the second object executes as a~~  
4 ~~callback on the first object, on said first computer.~~

1 Claim 23 (currently amended): ~~A computer~~ The computer program product as claimed in Claim  
2 ~~21 wherein said 20, wherein the reference table is a entry and the second reference table entry are~~  
3 ~~created as database entries.~~

1 Claim 24 (currently amended): A computer system for programmatically creating a distributed  
2 object program in which at least one complex object is passed as a parameter, wherein the  
3 programmatically-created program is programmatically generated from a programmer-written  
4 program which is not specially adapted for distributed execution, the distributing one or more  
5 objects of a program across more than one physical device, each object containing one or more  
6 programmed member functions, said member functions having complex objects, said complex  
7 objects including one or more programmed member functions, as parameters, said system  
8 comprising:

9 means for identifying all of the one or more objects in the programmer-written program,  
10 wherein each of the objects contains one or more programmed member functions and wherein at  
11 least one of the programmed member functions is written to pass one of the objects as a  
12 parameter;

13 means for determining which a first set of the identified objects which are to reside on a  
14 first computer and a second set which of the identified objects which are to reside on a second  
15 computer, wherein the first set and the second set together comprise the identified objects of the  
16 programmer-written program and the first set and the second set each include at least one of the  
17 identified objects; such that the distributed system will consist of at least a first object on a first  
18 computer and a second object on a second computer;

19 ~~means for identifying all programmed methods contained in each object that may be~~  
20 ~~accessed from a remote computer;~~

21 means for programmatically generating, upon detecting that a first object in the first set  
22 contains logic to call one of the programmed member functions of a second object in the second

23 set a first proxy and a second proxy for each the second object, wherein the first proxy is  
24 generated to be installed on the first computer and the second proxy is generated to be installed  
25 on the second computer;

26 means for programmatically generating logic in the first proxy that will programmatically  
27 generate a third proxy, responsive to detecting that the call to the programmed member function  
28 of the second object will pass, as a parameter, a third object that is a complex object and that is  
29 one of the objects in the first set, wherein the third proxy is generated to be installed on the first  
30 computer; and

31 means for programmatically generating logic in the second proxy that will  
32 programmatically generate a fourth proxy, responsive to a call from the first proxy that includes a  
33 reference to the third proxy, wherein the fourth proxy is generated to be installed on the second  
34 computer.

35 such that, at run time, the first object can transparently access the programmed member  
36 function of the second object and the programmed member function of the second object can  
37 transparently access a programmed member function of the third object, that may be accessed  
38 from a remote computer, said first proxy residing on said first computer and said second proxy  
39 residing on said second computer, said first proxy containing network linkage and indication to  
40 access programmed member functions on said second proxy on said second computer including  
41 logic to transfer and translate complex objects which reside on said first computer used as  
42 member function parameters and said second proxy containing linkage and indication to access  
43 said programmed member functions on said second object including logic to transfer and translate  
44 complex objects, said complex objects containing one or more programmed member functions

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45 ~~and reside on said first computer, used as member function parameters, and;~~  
46 ~~means for accessing said remote programmed methods through said proxies.~~

1 Claim 25 (currently amended): ~~A system~~ The system as claimed in Claim 24, wherein:

2 ~~said logic in said the first proxy on said first computer to transfer and translate complex~~  
3 ~~data objects comprising the steps of:~~

4 ~~creating a third proxy, for said complex object, which is to reside on said first~~  
5 ~~computer with said complex object, said third proxy containing linkage and indication to access~~  
6 ~~programmed member functions on said complex object;~~

7 ~~creating~~ further comprises programmatically-generated logic to (1) create a  
8 reference table entry which correlates said the third proxy object to said complex the third object,  
9 which may be accessed by said the third proxy object to access said complex when invoking  
10 programmed member functions of the third object; (2) translate calls for the programmed member  
11 function of the second object that are received from the first object and that pass the third object  
12 as a parameter, whereby a reference to the third proxy replaces the third object on the received  
13 calls, and forward the translated calls to the second proxy; and (3) upon receiving, from the  
14 second proxy, responses to the translated calls, return the responses to the first object; and;

15 ~~passing as a member function parameter to said second proxy on said second~~  
16 ~~machine a reference to said third proxy, in place of said complex object when said complex~~  
17 ~~object is to be a parameter in a member function call to said second object on said second~~  
18 ~~machine.~~

19 ~~said logic in said the second proxy on said second computer to transfer and translate~~

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20 ~~complex data objects comprising the steps of:~~

21 ~~\_\_\_\_\_ creating a fourth proxy for said complex object on said first computer which is to~~  
22 ~~reside on said second computer, said fourth proxy containing network linkage and indication~~  
23 ~~necessary to access programmed member functions on said third proxy on said first machine;~~

24 ~~\_\_\_\_\_ creating a further comprises programmatically-generated logic to (1) create a~~  
25 ~~second reference table entry which correlates said the fourth proxy to a to the reference to said~~  
26 ~~the third proxy on said third computer, which may be accessed by said the fourth proxy to access~~  
27 ~~said when forwarding calls to the third proxy; (2) invoke the programmed member function of the~~  
28 ~~second object, responsive to receiving one of the translated calls that is forwarded from the first~~  
29 ~~proxy, wherein the second reference table entry is consulted so that an indication of the fourth~~  
30 ~~proxy is substituted, on the invocation, for the reference to the third proxy; and (3) upon~~  
31 ~~receiving, from the programmed member function of the second object, a response to the~~  
32 ~~forwarded call, return the response to the first proxy;~~

33 ~~the fourth proxy further comprises programmatically-generated logic to (1) consult the~~  
34 ~~second reference table entry, responsive to receiving a call from the programmed member~~  
35 ~~function of the second object, thereby determining that the received call corresponds to the third~~  
36 ~~proxy; (2) translate the call received from the programmed member function of the second object~~  
37 ~~such that the translated call refers to the third proxy and forward the translated call to the third~~  
38 ~~proxy; and (3) upon receiving, from the third proxy, a response to the translated call, return the~~  
39 ~~response to the programmed member function of the second object; and~~

40 ~~the third proxy further comprises programmatically-generated logic to (1) consult the~~  
41 ~~reference table entry, responsive to receiving the translated call from the fourth proxy, thereby~~

42 determining that the received translated call corresponds to the third object; (2) translate the call  
43 received from the fourth proxy to invoke the programmed member function of the third object  
44 and forward the translated call to the third object, where the programmed member function of the  
45 third object will then be executed; and (3) upon receiving, from the programmed member function  
46 of the third object, a result of the execution, return the result to the fourth proxy.

47 ~~\_\_\_\_\_ passing as a member function parameter to said second object from said second~~  
48 ~~proxy on said second computer an indication of said fourth proxy, in place of said reference to~~  
49 ~~said third proxy on said first computer, which represents said complex object on said first~~  
50 ~~computer.~~

51 ~~\_\_\_\_\_ said network linkage and indication in said fourth proxy necessary to access programmed~~  
52 ~~member functions on said third proxy on said first computer comprising the steps of:~~

53 ~~\_\_\_\_\_ looking up said fourth proxy in said reference table on said second computer to~~  
54 ~~determine which object on said first machine said fourth object is a proxy for, said lookup~~  
55 ~~returning a reference to said third proxy on said first computer;~~

56 ~~\_\_\_\_\_ calling the appropriate programmed member functions in said third proxy on said~~  
57 ~~first computer.~~

58 ~~\_\_\_\_\_ said linkage and indication in said third proxy necessary to access programmed methods~~  
59 ~~on said complex object comprising the steps of:~~

60 ~~\_\_\_\_\_ looking up said third proxy in said reference table on said first computer to~~  
61 ~~determine which object on said first machine said third object is a proxy for, said lookup returning~~  
62 ~~a reference to said complex object on said first computer;~~

63 ~~\_\_\_\_\_ calling the appropriate programmed member functions in said complex object.~~

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1 Claim 26 (currently amended): ~~A system~~ The system as claimed in Claim 25 ~~wherein one of said~~  
2 ~~complex objects 24, wherein the third object is identical to the said first object, such that the call~~  
3 ~~to the programmed member function of the second object executes as a callback on the first~~  
4 ~~object, on said first computer.~~

1 Claim 27 (currently amended): ~~A system~~ The system as claimed in Claim 25 ~~wherein said 24,~~  
2 ~~wherein the reference table entry and the second reference table entry are created as is a database~~  
3 ~~entries.~~